ANSWERS: Describing and Explaining Enthalpy changes

1. $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$
The equation for the combustion of hydrogen is the same as the equation for the heat of formation of water

2. The enthalpy change when one mole of liquid water is converted to gaseous water under standard conditions. OR $H_2O(\lambda) \rightarrow H_2O(g)$

3. (i) $S_{(s)} + O_{2(g)} \rightarrow SO_{2\ (g)}$ $\Delta_cH\ (S_{(s)}) = \Delta_rH$

(ii) Because the equation for the enthalpy of formation of SO_2 is $S_{(s)} + O_{2(g)} \rightarrow SO_{2\ (g)}$. As this is the same equation as the enthalpy of combustion of S, as shown above so both equations will have the same enthalpy value

4. (i) The heat evolved / energy change when one mole of a substance is combusted / burnt in oxygen / reacted completely in oxygen under standard conditions

(ii) $\Delta_{fus}H^o$ $H_2O(s) \rightarrow H_2O(\lambda)$ $\Delta_{fus}H^o(H_2O) = 6.01$ kJ mol^{-1}
$\Delta_{vap}H^o$ $H_2O(\lambda) \rightarrow H_2O(g)$ $\Delta_{vap}H^o(H_2O) = 40.67$ kJ mol^{-1}
(iii) Less energy is required to overcome the attractive forces / hydrogen bonds between the solid molecules to turn them into a liquid, as only some of these forces need to be broken.
However, more energy is required to fully break all forces / hydrogen bonds between molecules in the liquid phase to vapourise the substance to turn them into a gas. Hence the $\Delta_{vap}H^o$ is always greater than the $\Delta_{fus}H^o$.

5. (i) The energy required to change (energy change) when 1 mole of a substance in its liquid phase changes into a gas (not molecules or compounds)

(ii) $\Delta_fH°$ ($CO_2(g)$) is equal to the enthalpy change for the reaction in which one mole of $CO_2(g)$ is formed from its elements in their standard state.
$C(s) + O_2(g) \rightarrow CO_2(g)$
This is also the equation for $\Delta_cH°$ (C (*s*)), the combustion of one mole of carbon under standard conditions.

6. (i) $Zn(s) + \frac{1}{2}O_2(g) \rightarrow ZnO(s)$

(ii) $ZnS(s) \rightarrow ZnS(\ell)$ STATES NEEDED

(iii) Energy / heat is absorbed / needed, to break forces between ions / particles, OR to separate particles to form a liquid.

7. The amount of energy required / energy change to form one mole of a gas from its liquid (at its boiling point, at standard state).

8. (i) $\frac{1}{2}O_2(g) + 2H_2(g) + N_2(g) + C(s) \rightarrow (NH_2)_2CO(s)$
(ii) $(NH_2)_2CO(s) \rightarrow (NH_2)_2CO(\lambda)$

9. $\frac{1}{2}H_2(g) + \frac{1}{2}Cl_2(g) \rightarrow HCl(g)$

10 (i) $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(\lambda)$
(ii) $\Delta_fH°$ (H_2O, λ) value applies to $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(\lambda)$ or stated in words.
Same reaction as $\Delta_cH°(H_2, g)$ so same energy values for both.